# FM10

## FM EXCITER/TRANSMITTER

## TECHNICAL MANUAL

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# 1 Introduction

The **Eddystone Broadcast Limited** FM10 has been designed for groups looking for low power FM transmission equipment. It can include a high quality deviation limiter and stereo encoder. With the addition of a low-cost aerial it is all that is needed to get on air.

Because of the broadband design of the unit, no tuning is required. Frequency setting is by means of internal, direct reading dial up switches. Output is automatically muted during lock-up time.

The stereo version is available with its own high quality deviation limiter and coder. This can be offered as an upgrade for the mono FM10. The unit will operate into any SWR without damage, with an effective VSWR protection circuit which reduces the output power if necessary to protect the amplifier.

## 2 Safety, Electrical hazard

This unit contains high voltages which could be fatal. YOU MUST ALWAYS ISOLATE THE UNIT FROM THE MAINS SUPPLY BY COMPLETELY DISCONNECTING IT BEFORE ATTEMPTING TO OPEN THE CASE.

THIS EQUIPMENT MUST BE EARTHED.

Do not expose this equipment to rain or any other source of moisture.

In common with all mains operated equipment, only suitably trained competent personnel should attempt to adjust, modify or repair this equipment or operate it with the cover removed. In case of query please contact your local agent or **Eddystone Broadcast Limited**.

Any unauthorised adjustment, modification or repair of this equipment may invalidate any warranty and/or safety approvals that apply.

Please read all of this manual and familiarise yourself with the controls before attempting to use this equipment.

To ensure safety, it is the responsibility of the user to install and operate this equipment in a manner that is within the manufacturers specifications.

## 3 Safety, Toxic hazard

This equipment includes devices which contain Beryllium Oxide which is a highly toxic substance. Inhalation or ingestion of even tiny particles could be injurious to health or even FATAL!

Extreme care must be exercised when replacing and discarding components which may contain Beryllium Oxide. If any such device is physically damaged you should seek expert advice, e.g. by contacting the device's manufacturers.

All such devices must be disposed of in accordance with local regulations. In the UK your local council will have a toxic waste disposal department who will be able to advise you. Elsewhere you should contact the responsible authorities.

NEVER DISPOSE OF A DEVICE CONTAINING BERYLLIUM OXIDE WITH GENERAL WASTE.

## 4 Unpacking

This package should contain:-

1x FM10 Series broadcast exciter/transmitter
1x IEC Mains lead
1x FM10 series manual

If any items are missing or damaged please inform your supplier immediately.

Initial Checks

Ensure that the FM10 has been set to the correct mains/line voltage for your country. The standard version is set to 230V.

## 5 Controls and Connectors

Front Panel:

POWER — Mains power is applied.

LIMIT — The audio input level is high enough for the limiter to reduce its level (where fitted).

Rear Panel:

Audio input — Unbalanced on female BNC connector without internal limiter or balanced on female XLR connector with optional limiter (pin 2 hot, 3 cold and 1 ground).

EXT MPX Loop — Multiplex output (unbuffered) on BNC connector, switchable multiplex input on BNC connector. If switch is in ON position, the multiplex is disconnected internally. If switch is in OFF position, the external multiplex input is disabled and the multiplex signal is connected internally.

Monitor — 25 way female D-type.

- Pin 1 Power supply OK
- Pin 2 Forward power OK
- Pin 4 Mute RF output
- Pin 5 - 24 reserved.
- Pin 25 Ground

The power supply OK and forward power OK outputs are open collector and are normally low/ON in the normal condition. The Mute input should be grounded to mute the output. This connector is not normally fitted on cable distribution versions.

O/P Monitor — Monitor of RF output (approx. -40dBc). This output should **not** be used to measure harmonic/spurious levels.

RF Out — 50Ω N type female connector.

Power — Multi turn power control.

Mains — Filtered IEC male connector with T1A fuse in pull out drawer.

## 6 Installation

The FM10 is normally supplied ready aligned, therefore installation should be straight forward. Before installation please read the section of this manual about Electrical safety.

RF leads should be made from high quality low loss cable and connectors of the correct impedance, using the manufacturers recommended termination techniques. Since connectors are a source of unreliability in any system, the number of terminations in any RF lead should be kept to a minimum.

All other cables for audio and control signals should be high quality screened types. For XLR connectors, the screen should be connected to the connector body.

## 7 Alignment

The FM10 is usually supplied ready aligned and therefore the following steps should not normally be necessary:-

7.1 Frequency setting
7.2 Output power/level
7.3 Forward power alarm
7.4 Modulator input level
7.5 DLM3 PCB
7.6 LimX PCB

When an automatic change over system is in use (such as the ACU3) this should be disconnected/overridden such that the FM10 operates continuously during the set-up procedure.

### 7.1 FREQUENCY SETTING

Setting the frequency is a simple operation. Direct reading dials are located on the PLL7 PCB. For example, to set a frequency of 107.30MHz, set the 10MHz dial to 0, the 1MHz dial to 7, the 100kHz dial to 3 and the 12.5kHz dial to 0. For 98.35 set 10MHz dial to 9, the 1MHz dial to 8, the 100kHz dial to 3 and the 12.5kHz dial to 4 (4 x 12.5kHz = 50kHz).

Whilst the Phase Locked Loop is Locking up the modulator output is muted (indicated by the PLL LOCK LED on the PLL7 PCB). When the FM10 is either powered up or the frequency changed, it will normally take about 5 seconds for the PLL to lock up. However if the frequency is changed from a high one to one at the bottom of the band, with the unit in operation, it can take up to 10 seconds for the PLL to attain lock.

## 7.2 OUTPUT POWER/LEVEL

A small trimmer tool or precision screwdriver will be required to adjust the output power. The control is located on the rear panel.

The output power should be set using an accurate power meter connected to the RF output which in turn should be connected to an adequately rated dummy load. If a dummy load is not available then the FM10 could be set up connected to the aerial. In this case the Output Power control should be set to minimum (anti-clockwise) before powering up the FM10.

## 7.3 FORWARD POWER ALARM

This setting defines the point at which a forward power fault is indicated at the Control/Monitor socket (for telemetry and/or operation of an automatic change over system). This is not adjustable on the FM10. It is pre-set to about 3W.

## 7.4 MODULATOR INPUT LEVEL

The setting of the modulator AUDIO LEVEL control (on the PLL7 PCB) will depend on the version supplied. For the FM10/M please read the section below headed DLM3 PCB and for the FM10/S please read the section headed LimX PCB. An accurate deviation meter will be required, which should be connected to the rear panel RF monitor socket (or output on the cable distribution version).

Mono/MPX version (no limiter or stereo encoder)

The FM10 is normally supplied with the modulator input level set so that an input level of +8dBu over the range 5Hz to 100kHz (without pre-emphasis) gives a deviation of 75kHz. If a different level is required then it will be necessary to reset the AUDIO LEVEL control on the PLL7 board. Apply a 400Hz sine wave at the level required for maximum deviation (normally 75kHz). Adjust the AUDIO LEVEL control to give the required deviation.

Full details of the alignment procedure are available on request from Eddystone Broadcast.

## 7.5 DLM3 PCB

### 1 FET BIAS

Connect an audio input at 400Hz to the Mono input that is below the limit threshold, for example -20dBu.

Turn R33 fully anti clockwise. Connect an oscilloscope or level meter to U3 pin 7. Turn R33 slowly clockwise until the level is reduced by 0.1dB. The level will vary whilst R33 is turned.

### 2 MODULATOR INPUT LEVEL

Connect an audio input at 400Hz to the audio input such that the front panel limit LED is fully ON. LINK TP1 on the DLM3 PCB to ground. This disables the limiter, leaving the clipper active. Adjust the AUDIO LEVEL control on the PLL7 PCB to give 75kHz minus your desired Guard-band of deviation. A typical value would be between 55 and 65 kHz. Disconnect the ground link from TP1.

### 3 INPUT LEVEL

Connect an audio oscillator to the audio input. Set its output to 400Hz and the output level to the desired limit threshold. Turn R19 fully anti clockwise. Connect an oscilloscope to the MPX OUTPUT connector. Turn R19 clockwise and observe that the peak level shown on the oscilloscope increases. Stop adjusting R19 at the point where the peak level stops increasing.

## 7.6 LimX PCB

### 1 FET BIAS

Connect an audio input at 400Hz to the LEFT and RIGHT or mono inputs that is below the limit threshold, for example -20dBu.

Turn R40 and R31fully anti clockwise. Connect an oscilloscope or level meter to U7 pin 7. Turn R31 slowly clockwise until the level is reduced by 0.1dB. The level will vary whilst R31 is turned. Connect the oscilloscope/level meter to U6 pin 7. Turn R40 slowly clockwise until the level is reduced by 0.1dB. The level will vary whilst R40 is turned.

### 2 MODULATOR INPUT LEVEL

Connect an audio oscillator, level +8dBu at 1kHz to the MPX IN socket and turn the EXT MPX LOOP switch on (right position). Using a deviation meter, adjust the AUDIO LEVEL control on the PLL7 PCB to give 75kHz deviation. Return the EXT MPX LOOP switch to the OFF position (left).

### 3 LimX OUTPUT LEVEL

Connect an audio input at 400Hz to the LEFT and RIGHT audio inputs such that the front panel limit LED is fully ON. LINK TP1 on the LimX PCB to ground. This disables the limiters, leaving the clippers active. Switch the pilot off. Adjust R1 to give 75kHz minus 6.75kHz minus your desired Guard-band deviation. A typical value would be between 50 and 60 kHz. Disconnect the ground link from TP1.

### 4 INPUT LEVEL

Switch the pilot off. Connect an audio oscillator to the left and right inputs. Set its output to 400Hz and the output level to the desired limit threshold. Turn R15 and R3 fully anti clockwise. Connect an oscilloscope to the MPX OUTPUT connector. Turn R15 clockwise and observe that the peak level shown on the oscilloscope increases. Stop adjusting R3 at the point where the peak level stops increasing. Now adjust R15 clockwise until the waveform is a pure sine wave.

### 5 PILOT LEVEL

Disconnect the audio input. Switch the pilot on. Adjust R86 to give a deviation of 6.75kHz.

In any of the above cases, if an RDS/SCA unit is to be connected, the output level of it may need re-calibration.

## 8 Specifications

| | |
|---|---|
| Frequency range | 87.5 to 108 MHz in 50kHz steps |
| Frequency stability | <± 200Hz |
| Power output | 1 - 10W |
| Harmonic & spurious output | < -76dBc |
| AM noise | < -50 wrt 100% |
| Nominal input level | 0dBu or +8dBu (adjustable) |
| Input | Electronically balanced with limiter or unbalanced |
| Input impedance | 20 kΩ |
| CMRR | 54dB (typ.) |
| Pre-emphasis | 50uS |
| AF response (with pre-emphasis) | <±0.5dB (50Hz-15kHz) |
| THD | < 0.15% at 75kHz |
| Power supply | $230V_{AC}$ ±10% |
| Power consumption | < 40VA |
| Dimensions | 1Ux260mm |

## 9 How to contact Eddystone Broadcast Limited

For all enquiries write to:-

**Eddystone Broadcast Limited**
26 Arden Road
Arden Forest Industrial Estate
Alcester
Warwickshire
B49 6EP

Or telephone 01789 762278 within the UK, +44 1789 762278 from outside the UK.

Or fax 01789 766033 within the UK, +44 1789 766033 from outside the UK.

Or email sales@eddystone-broadcast.com

Alternatively visit our web site: http://www.eddystone-broadcast.com/

## 10 Technical Section Contents


| | | |
|---|---|---|
| 10.1 | PLL7 | Modulator PCB |
| 10.2 | PSU15 | Power Supply PCB |
| 10.3 | DLM3 | Limiter PCB (FM10/M only) |
| 10.4 | LimX | Stereo coder (FM10/S only) |
| 10.5 | FM10-PA | 10W Power amplifier |

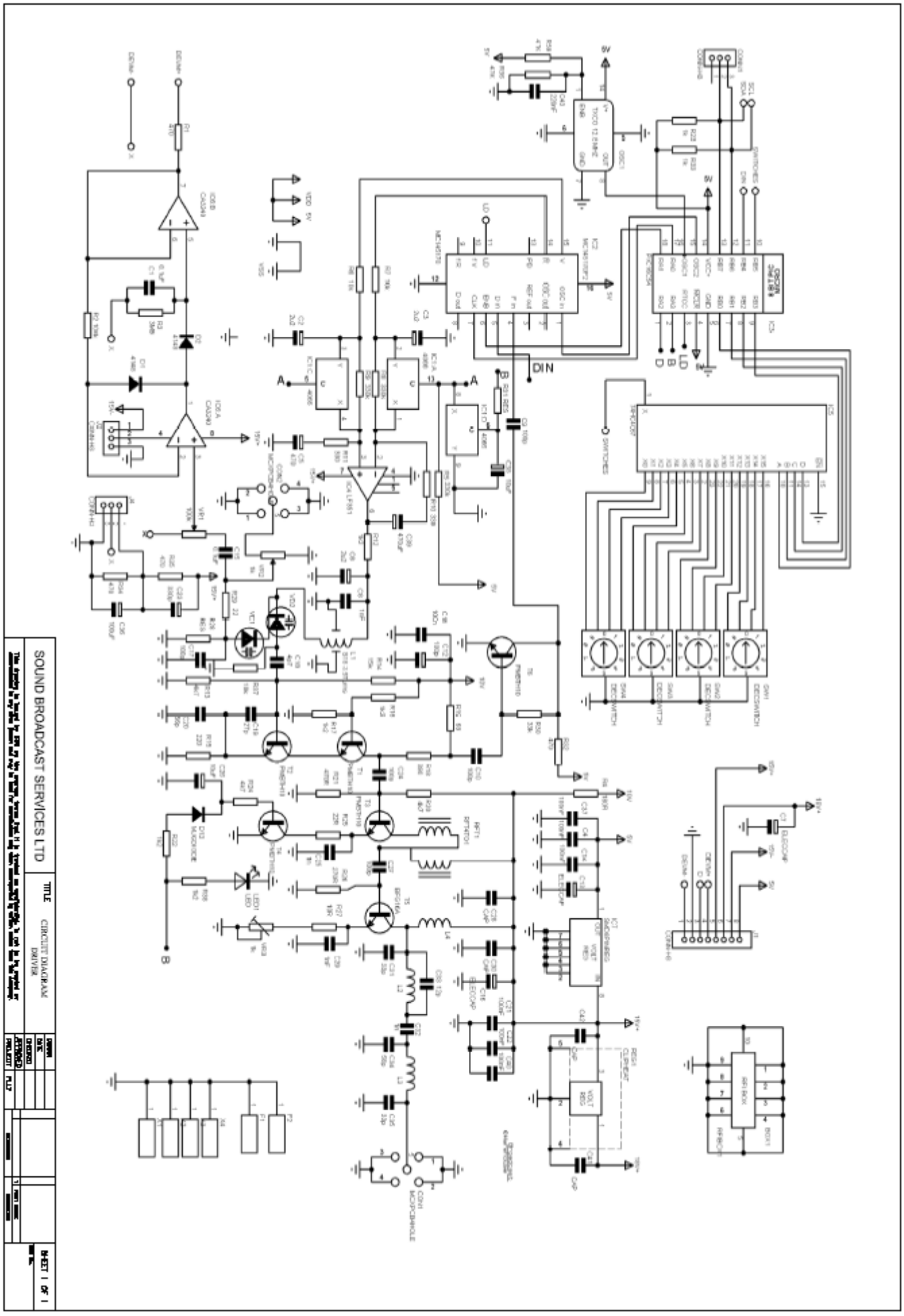
## 10.1 PLL7

The frequency determining element is formed by coil L1 and varicap diodes VD1 and VD2, together with capacitors C17- C20. These components are used as part of a cascode oscillator whose output is then buffered by transistor T3. The RF output from T3 is impedance matched to the base of transistor T5 by RFT1, a 4 to 1 matching transformer. The high power output from T5 is impedance matched by coils L2 and L3 and associated capacitors to the 50 ohm output socket CON2. These components also provide harmonic filtering.

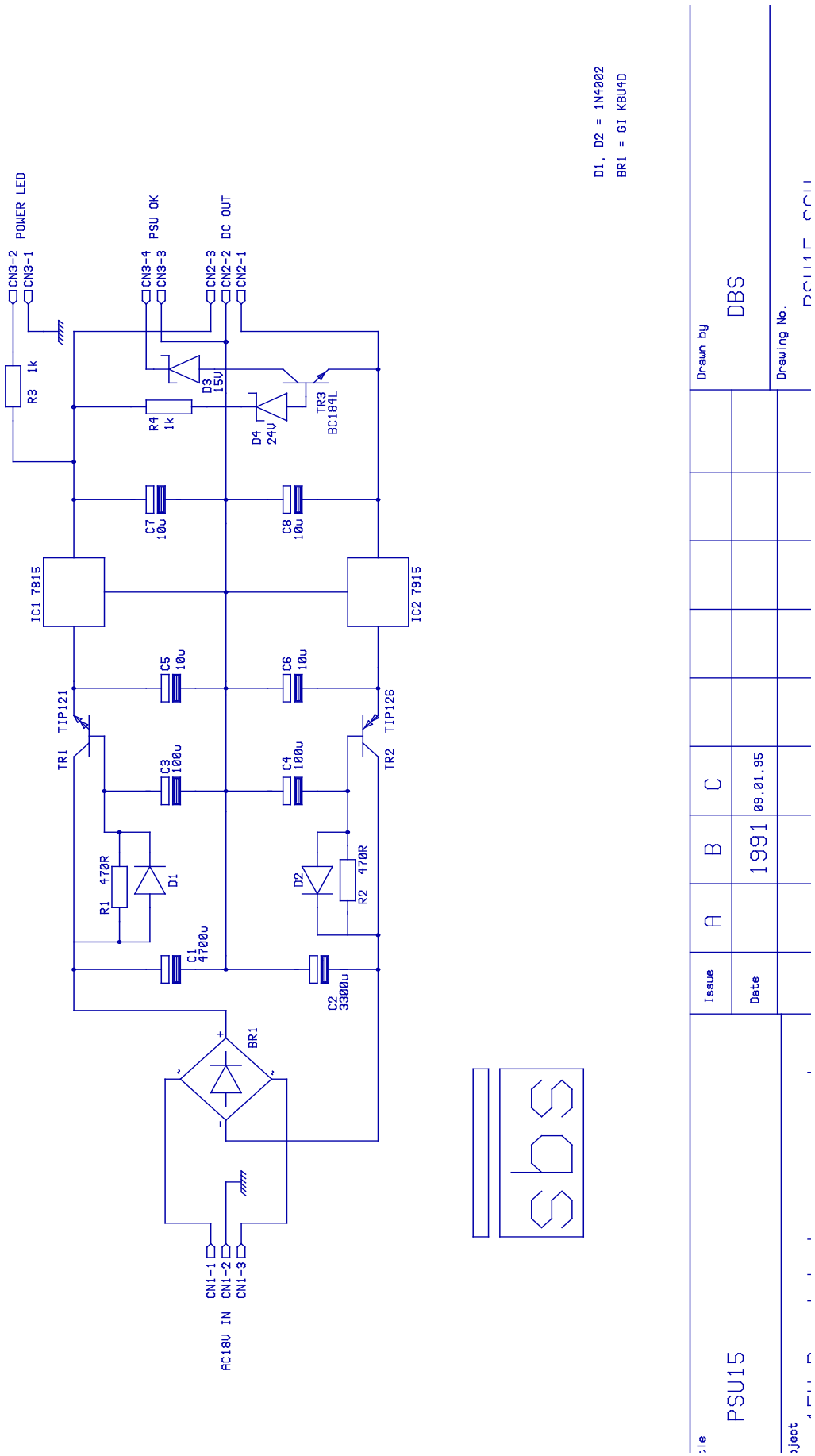
The PLL circuit is primarily IC2 which is a serially programmable PLL chip. The microcontroller IC3 reads the dial switches at switch on and outputs a serial code to the PLL chip in a format that determines the output frequency that the PLL will try and lock the transmitter to. The PLL chip outputs control pulses to the loop filter built around op amp IC4. The loop filter takes the sharp pulses from the PLL chip and converts them into a smoothed signal ready to apply to the frequency determining components, varicap diodes VD1 and VD2. IC1 is an analogue switch that shorts out two of the resistors in the loop filter which enables the transmitter to get on frequency faster. When the oscillator is on frequency the Analogue switch switches out which greatly improves the audio response of the transmitter. The microcontroller IC3 determines when to switch the analogue switch in and out by reading the lock detect signals from the PLL chip. The microcontroller can also use this information to switch off transistor T3 with open collector configured T4 which mutes the RF output when the transmitter is out of lock. LED1 provides visual indication of the PLL locked condition.

The master clock oscillator (OSC1) determines the accuracy of the output frequency. It is a high stability temperature compensated crystal oscillator (TCXO). The frequency can be trimmed if required by adjusting the small trimmer located beneath a hole in the oscillator module.

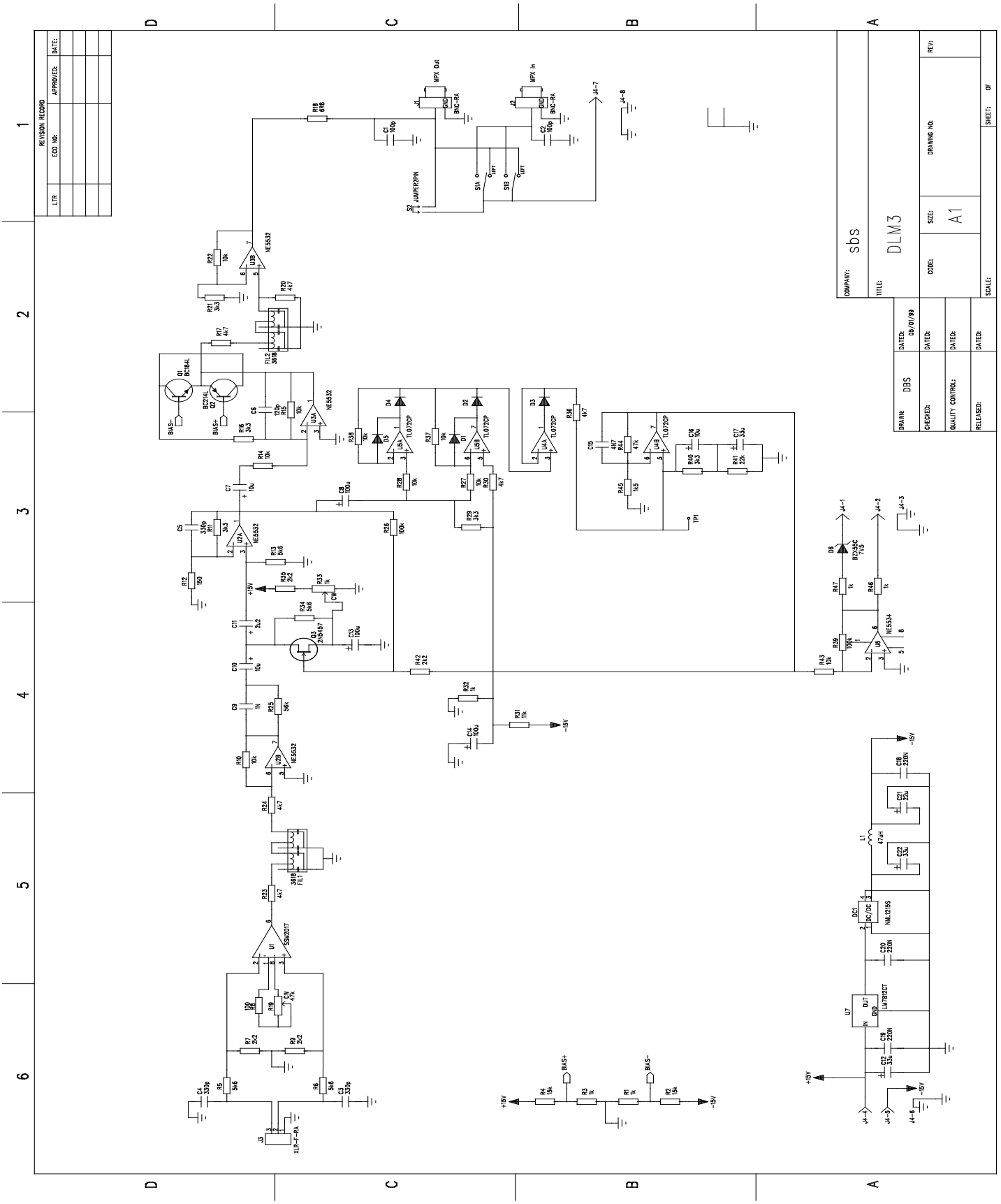
Audio is fed into the modulation input connector CON2. From here the signal passes to variable resistor VR2 where modulation levels can be set, it is then passed via R29 to the varicap diodes.

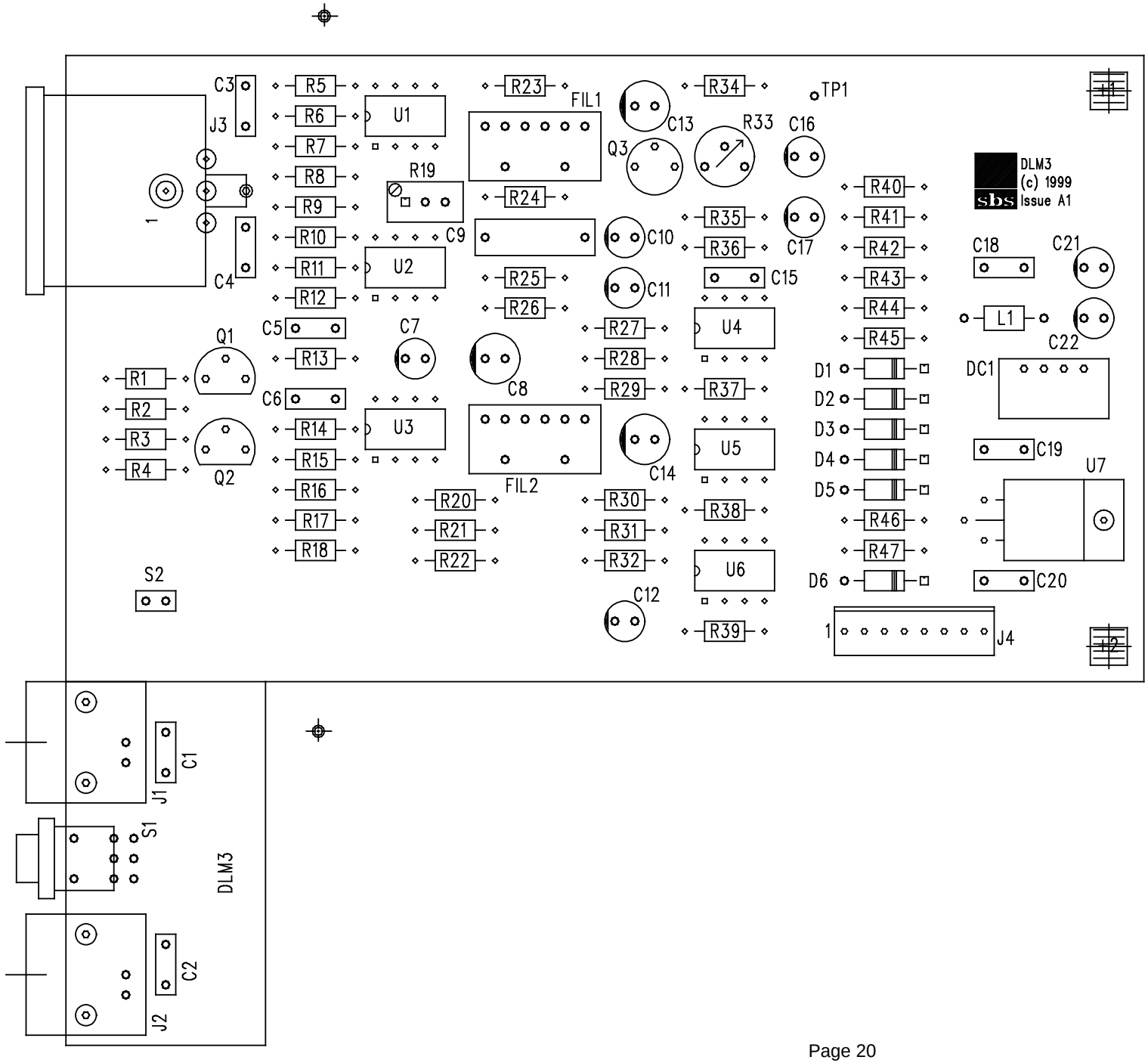

SOUND BROADCAST SERVICES LTD
TITLE
CIRCUIT DIAGRAM
DRIVER
DRAWN
DATE
CHECKED
APPROVED
PROJECT
FILE
SHEET 1 OF 1
DIN
LD
D
B
A

## 10.2 PSU15

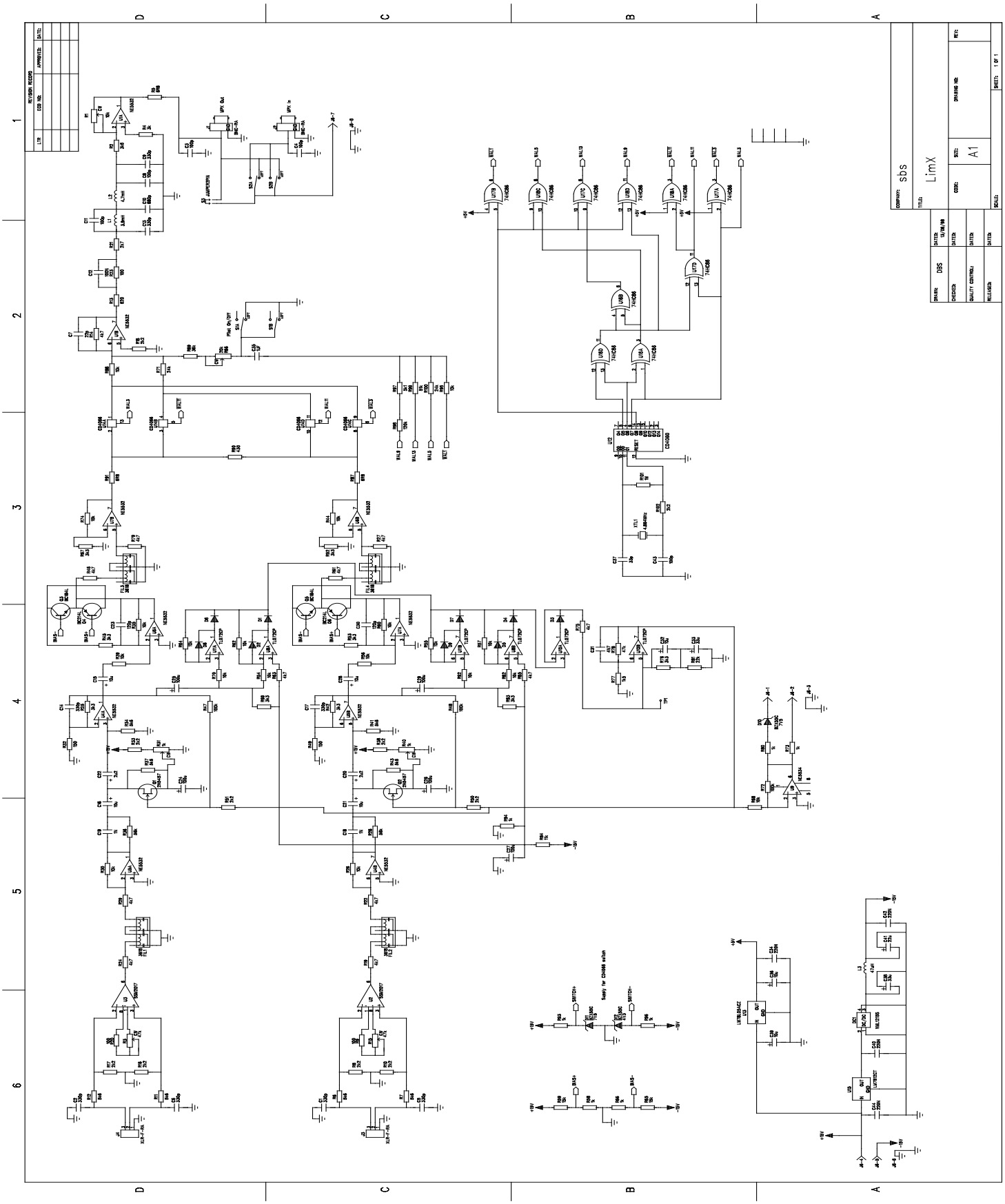

D1, D2 = 1N4002
BR1 = GI KBU4D
CN3-2 POWER LED
CN3-1
CN3-4 PSU OK
CN3-3
CN2-3 DC OUT
CN2-2
CN2-1
R3 1k
R4 1k
D3 15V
D4 24V
TR3 BC184L
C7 10u
C8 10u
IC1 7815
IC2 7915
C5 10u
C6 10u
TR1 TIP121
TR2 TIP126
C3 100u
C4 100u
R1 470R
D1
D2
R2 470R
C1 4700u
C2 3300u
BR1
CN1-1
CN1-2
CN1-3
AC18V IN
Issue
A
B
C
Date
1991
09.01.95
Drawn by
DBS
Drawing No.
PSU15

## 10.3 DLM3




C3
J3
1
C4
R5
R6
R7
R8
R9
R10
R11
R12
U1
U2
R19
C9
C5
R13
C7
C6
R14
R15
R16
R17
R18
U3
Q1
Q2
R1
R2
R3
R4
S2
R23
FIL1
R24
R25
R26
C8
FIL2
R20
R21
R22
C10
C11
R27
R28
R29
C14
R30
R31
R32
C12
R34
TP1
C13
R33
C16
Q3
R35
R36
C17
C15
U4
R37
U5
R38
U6
R39
R40
R41
R42
R43
R44
R45
D1
D2
D3
D4
D5
R46
R47
D6
1
J4
DLM3
(c) 1999
sbs
Issue A1
C18
C21
L1
C22
DC1
C19
U7
C20
J1
C1
S1
DLM3
J2
C2

## 10.4 LimX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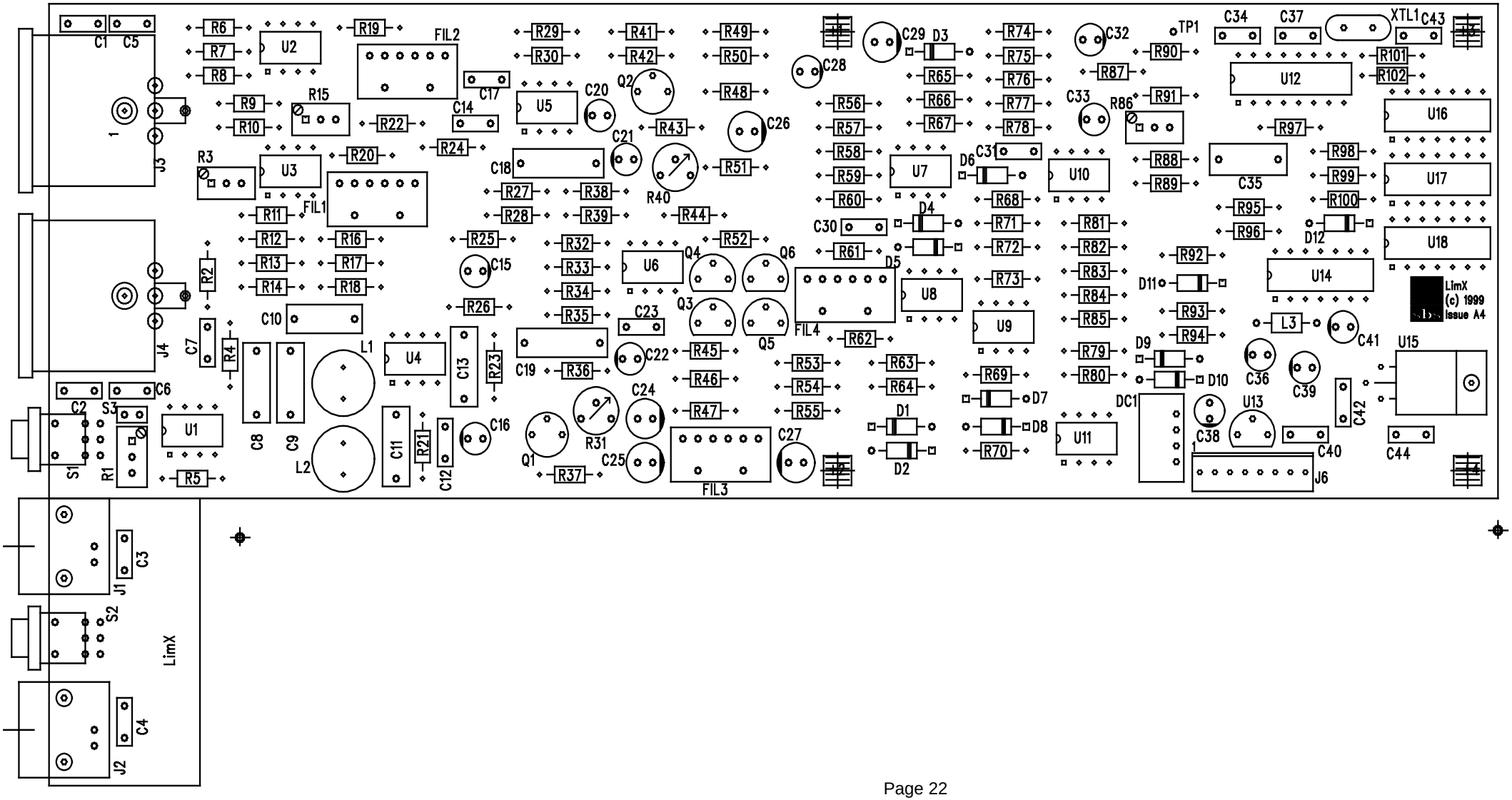
CHECKED:
QUALITY CONTROL:
RELEASED:


C1
C5
R6
R7
R8
U2
R19
FIL2
R29
R30
R41
R42
R49
R50
C17
C14
R15
R9
R10
R22
R24
U5
C20
Q2
R43
R48
C26
C21
R40
R51
C18
R27
R28
R38
R39
R44
R3
U3
R20
FIL1
R11
R12
R13
R14
R16
R17
R18
R25
R26
C15
U6
Q4
Q6
R52
R32
R33
R34
R35
C23
C22
Q3
Q5
R45
R46
R47
C19
R36
C24
R31
Q1
R37
C25
FIL3
C27
C28
C29
D3
R65
R66
R67
R56
R57
R58
R59
R60
U7
C30
R61
D4
D5
FIL4
R62
U8
R53
R54
R55
R63
R64
D1
D2
R74
R75
R76
R77
R78
D6
C31
R68
R71
R72
R73
U9
R69
D7
D8
R70
U10
R81
R82
R83
R84
R85
R79
R80
U11
C32
R87
C33
R86
TP1
R90
R91
R88
R89
D9
D10
DC1
C38
U13
J6
C34
C37
XTL1
C43
U12
R101
R102
R97
U16
R98
R99
R100
U17
C35
R95
R96
D12
U18
R92
D11
R93
R94
U14
L3
C41
C36
C39
C42
C40
C44
U15
LimX
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Issue A4
J3
J4
R2
C7
R4
C8
C9
C10
L1
L2
U4
C13
R23
C11
R21
C12
C16
C2
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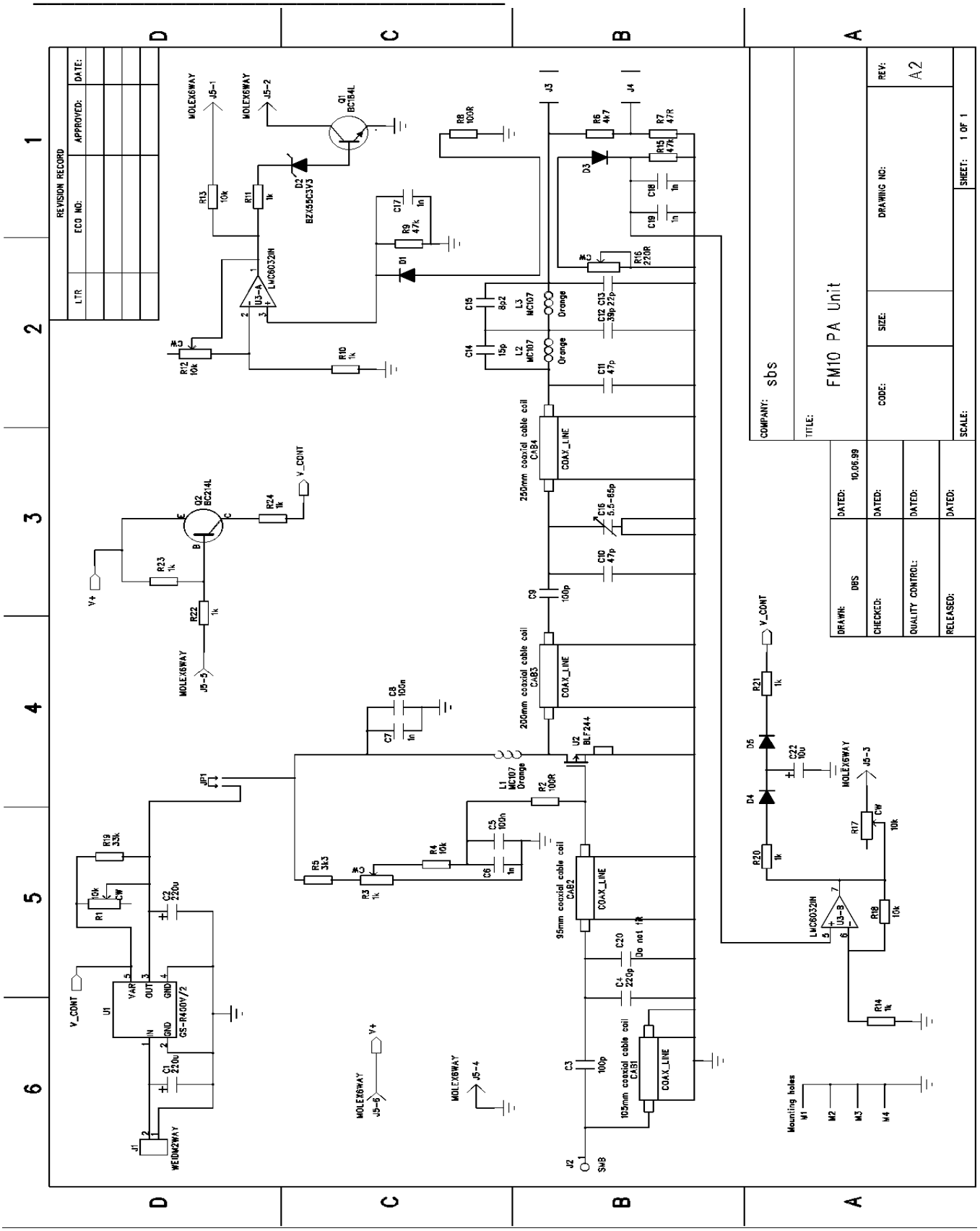
R5
C6
J1
C3
S2
J2
C4
LimX

## 10.5 FM10-PA


FM10 PA Unit
COMPANY: sbs
TITLE:
DRAWN: DBS
DATED: 10.06.99
CHECKED:
QUALITY CONTROL:
RELEASED:
SIZE: A2
SHEET: 1 OF 1
REVISION RECORD
LTR
ECO NO:
APPROVED:
DATE:
J1 WEIDM2WAY
J2 SwB
J3
J4
J5-1 MOLEX6WAY
J5-2 MOLEX6WAY
J5-3 MOLEX6WAY
J5-4 MOLEX6WAY
J5-5 MOLEX6WAY
J5-6 MOLEX6WAY
U1 GS-R400V/2
U2 BLF244
U3-A LMC6032IN
U3-B LMC6032IN
Q1 BC184L
Q2 BC214L
D1
D2 BZX55C3V3
D3
D4
D5
JP1
L1 MC107 Orange
L2 MC107 Orange
L3 MC107 Orange
CAB1 COAX_LINE
CAB2 COAX_LINE
CAB3 COAX_LINE
CAB4 COAX_LINE
95mm coaxial cable coil
200mm coaxial cable coil
250mm coaxial cable coil
105mm coaxial cable coil
Mounting holes
M1
M2
M3
M4
V_CONT
V+

## 11 Declaration of conformity

Name of Manufacturer: **sbs**

Product: FM10 FM Exciter

Declaration:

The product described above compiles with the requirements of the Low Voltage Directive (73/23/EEC) and the protection requirements of the EMC Directive (89/336/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Standards:

| | |
|---|---|
| EN 60065:1998 | Safety requirements for mains operated electronic and related apparatus for household and similar general use |
| EN 50081-2:1994 | Electromagnetic compatibility. Generic emission standard. Industrial environment |
| EN 50082-2:1995 | Electromagnetic compatibility. Generic immunity standard. Industrial environment |

Additionally, the product described above complies with all relevant parts of the following standards:

| | |
|---|---|
| ETS 300 384:1995 | Radio broadcasting systems; Very High Frequency (VHF), frequency modulated, sound broadcasting transmitters |

| | | | |
|---|---|---|---|
| Signed: | | Date of Issue: | |
| | On file | | 16. 05. 2001 |
| for and on behalf of **sbs**, UK | Pyers Easton<br>CEO | | |